

DuPont Corporate Remediation Group
Barley Mills Plaza – Bldg. 27
Lancaster Pike & Rte. 141
Wilmington, DE 19805
(302) 992-4366

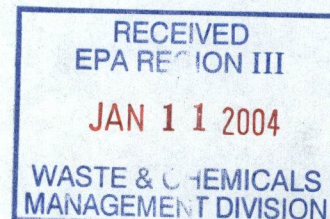


DuPont Corporate Remediation Group

January 5, 2005

Airborne Express

Ms. Rachel Colella, Environmental Scientist
Solid & Hazardous Waste Management Branch
Division of Air & Waste Management, DNREC
89 Kings Highway
Dover, DE 19901



TRANSMITTAL OF FINAL REVISIONS TO PHASE II FINAL RFI REPORT
SEAFORD NYLON PLANT

Dear Ms. Colella:

In response to DNREC's comment letter dated November 3, 2004 and our meeting with you on December 3rd, 2005 in your offices, attached please find the final revisions you requested for the RFI Report. A replacement report cover and text pages (with revisions underlined) and a new Appendix F are attached for insertion into your existing 3-ring binder. Appendix F is the additional data regarding the occurrence of Iron; this data had been previously submitted to EPA/DNREC in a letter dated August 5, 2004 and in a memorandum entitled *Iron in the Environment in the Seaford Region* (dated October 1, 2004), submitted via e-mail to DNREC on October 4, 2004.

Should you have any additional questions, please feel free to contact either myself (302) 892-7421) or our technical consultant, Mr. Matt Brill (302 892-7576) of URS Corporation. I look forward to continuing to work with DNREC and EPA to work towards completion of the Corrective Measures Study (CMS) and receiving a "complete with controls" designation for the Facility.

Sincerely,

Michael R. Liberati
Project Director
DuPont Corporate Remediation Group

Attachments (2 sets)

B. Greaves, EPA Region III
M. Terry, DuPont Seaford
M. Brill, URS Diamond/DuPont CRG
File

This entire appendix added as part of January 5, 2005 revisions.

APPENDIX F

**EPA/DNREC SUBMITTALS of AUGUST 5 and
OCTOBER 1, 2004**



DuPont Corporate Remediation Group

August 5, 2004

Airborne Express

Ms. Diane Schott, RPM (3WC23)
USEPA, RCRA General Operations Branch
1650 Arch Street
Philadelphia, PA 19103-2029

TRANSMITTAL OF ADDITIONAL DATA FOR THE SWMU 17 AREA
SEAFORD NYLON PLANT
PHASE II RFI

Dear Ms. Schott:

As a follow up to our recent discussions with EPA and DNREC, attached please find data (i.e. "Powerhouse Ash Landfill 2004 Annual Hydrogeologic Report") which address the issue of iron in the SWMU 17 (Ash Landfill) and Forested Wetlands area.

DuPont still believes that the majority of the iron in the area is from natural sources. The concentration of iron in the Columbia Formation is in general (or on average) very high. However, there is typically large variability in the concentration depending on locations. Iron concentrations can be widely different, from very low to very high levels, over the distance of a few thousand feet. In support of the statement that some groundwater in the area has naturally high iron, are the high iron concentrations in wells MW-8s and MW-9s. These two wells, MW-8s and MW-9s, are clearly upgradient of the ash landfill. Using the data tables in Appendix D of the attached "Powerhouse Ash Landfill 2004 Annual Hydrogeologic Report", they show the range of iron concentrations from the years 1989 to 2004 in well MW-8s to be from 10,000 ug/l to 125,000 ug/l. The table for well MW-9s show the range of iron concentrations from the years 1989 to 2004 to be from 99 ug/l to 25,400 ug/l.

The range of iron concentrations for downgradient well MW-17s for the years 1999 to 2004 is from 15,900 ug/l to 49,700 ug/l. DuPont regrets not including this supporting data from the Ash Landfill monitoring program in the Phase II Report, but has attached the just completed "Powerhouse Ash Landfill 2004 Annual Hydrogeologic Report" for your use. Because the Annual Hydrogeologic Report only shows the current year's groundwater flow direction, please find additional groundwater flow direction maps from earlier years in the jacket pocket of the Report binder. These were included at the request

of Dr. Ruth Prince, and should provided you with a comfort level that the wells MW-8s and MW-9s are indeed upgraident of the ash landfill.

Table 7 of the Phase II RFI Report is intended to show a comparison of the Creek surface water sample results to the criteria found in the DNREC document entitled State of Delaware Surface Water Quality Standards as amended August 11, 1999. Table 1 of this document provides "Water Quality Criteria for Protection of Aquatic Life; Freshwater Chronic" (i.e. SWQC). These are legally enforceable standards promulgated under the Federal Clean Water Act and 7 Delaware Code Chapter 60. When using the Aquatic Life criteria the sample result should be a filtered sample. This filtered sample represents the dissolved concentration, which is typical the material which is bio-available to most aquatic life. The total (i.e. unfiltered) results were placed on the table for completeness, not for comparison purposes. The URS criteria is the same number as the SWQC, i.e. 1,000 ug/l. Therefore, all dissolved surface water results for iron for Lewis Creek are below those standards. Because there is no surface water exceedance for iron and the high sediment iron results are from a natural source, DuPont feels that no further investigation of the effect of the iron on the forested wetlands is justified.

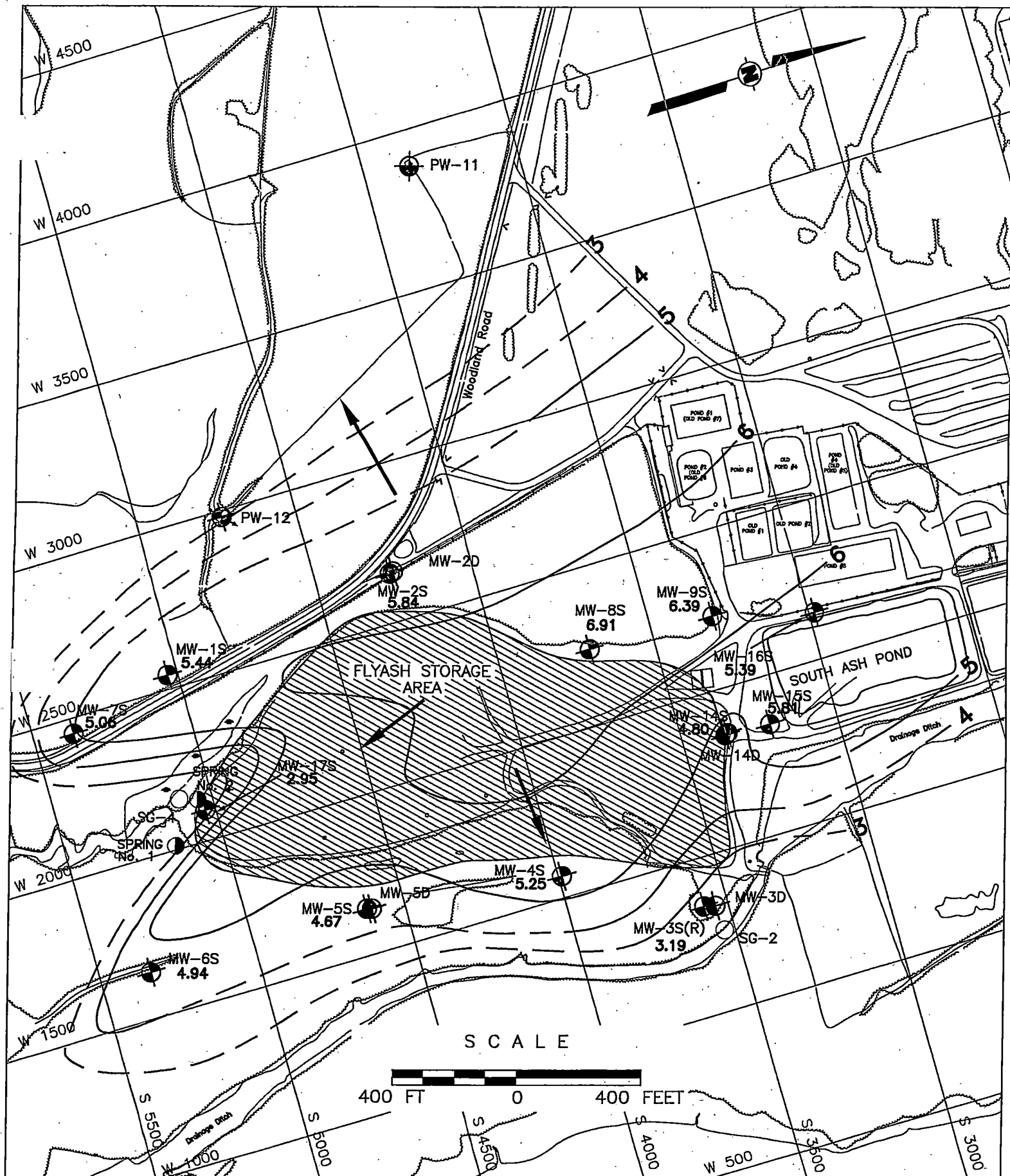
Should you have any additional questions, please feel free to contact either myself (302) 892-7421) or our technical consultant, Mr. Matt Brill (302 892-7576) of URS Corporation. I look forward to continuing to work with DNREC and EPA to work towards completion of the RFI.

Sincerely,



Michael R. Liberati
Project Director
DuPont Corporate Remediation Group

R. Colella, DNREC SHWB
B. Greaves, EPA Region III (w/o attachments)
M. Terry, DuPont Seaford (w/o attachments)
M. Brill, URS Diamond/DuPont CRG (w/o attachments)



LEGEND:

- ⊗ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-5S 3.17 ⊗ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



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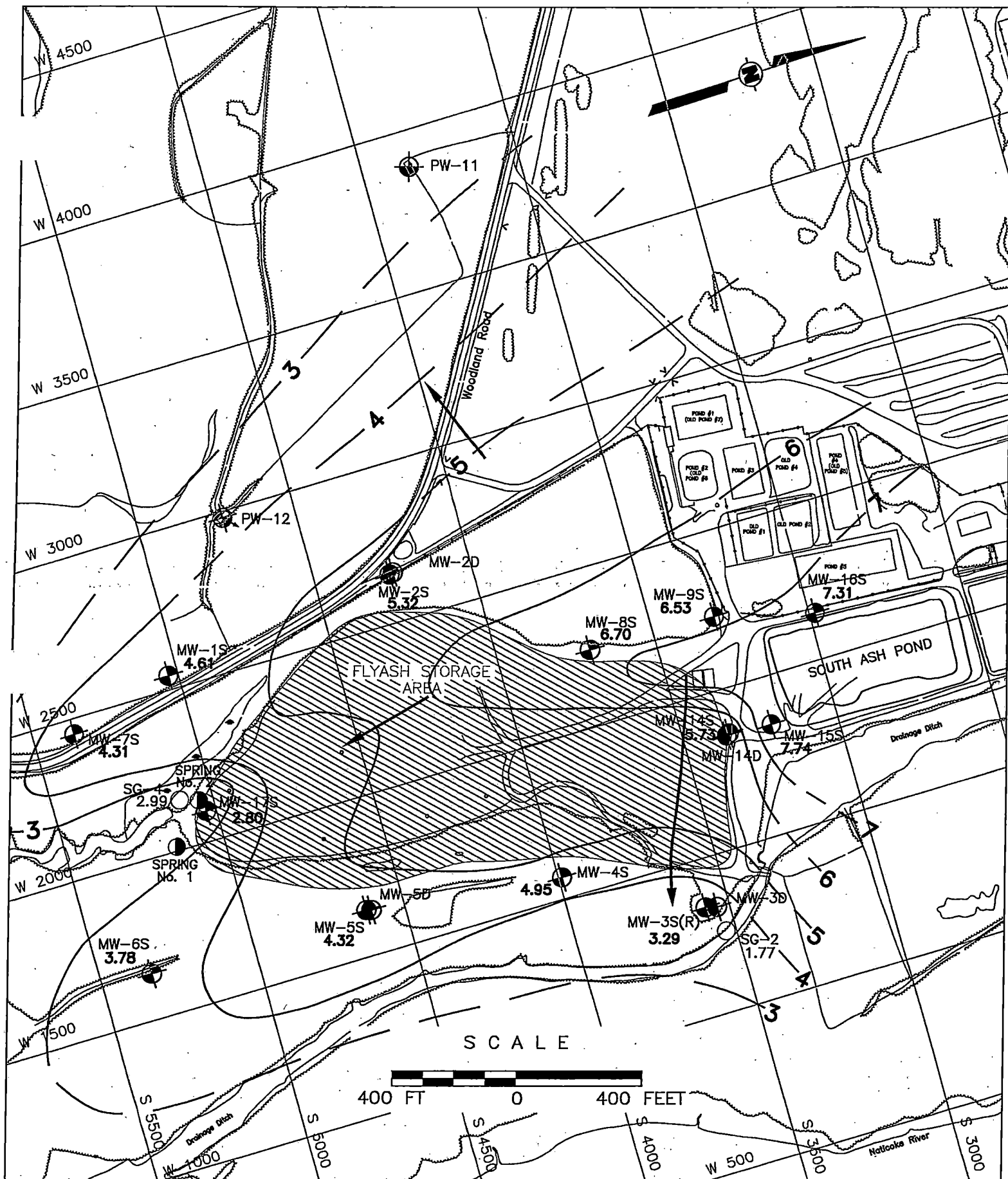
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805



**SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP APRIL, 2004**

Seaford Flyash Landfill
Seaford, Delaware

SCALE As shown	DESIGNED	DRAWN	DEL	CAD FILE NO. Shallow Aquif
DATE 7/8/04	CHECKED DEV	APPROVED	FIGURE 2	



LEGEND:

- SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-5S 3.94 MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



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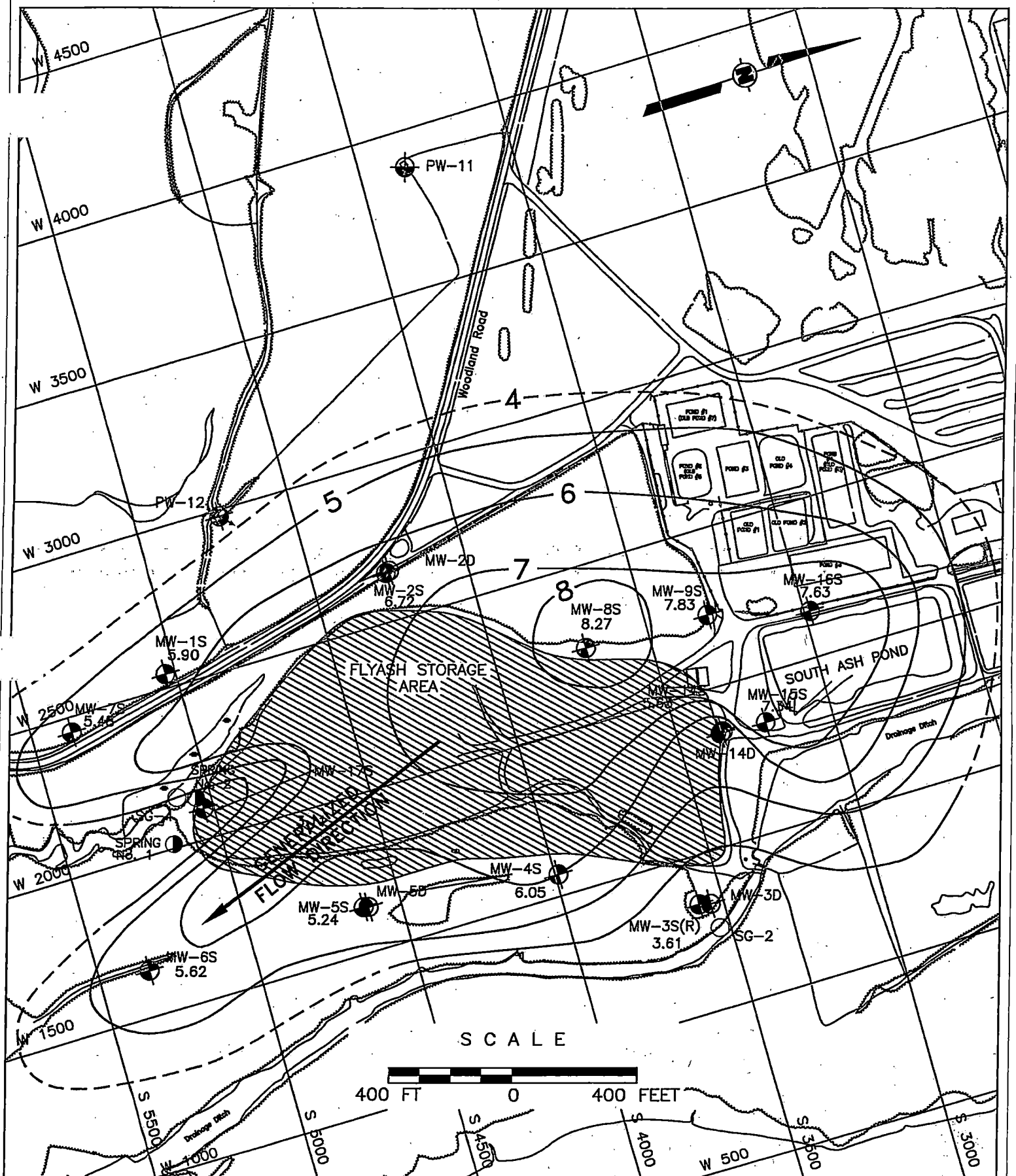
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027



SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP OCTOBER, 2003

Seaford Flyash Landfill
Seaford, Delaware

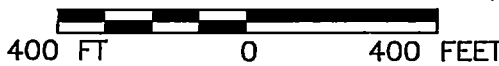
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DATE 12/04/03	CHECKED DEV	APPROVED	8052_DCT_03SHALLOW
			FIGURE 1



LEGEND:

- ⊗ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-5S 3.17 ⊗ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE

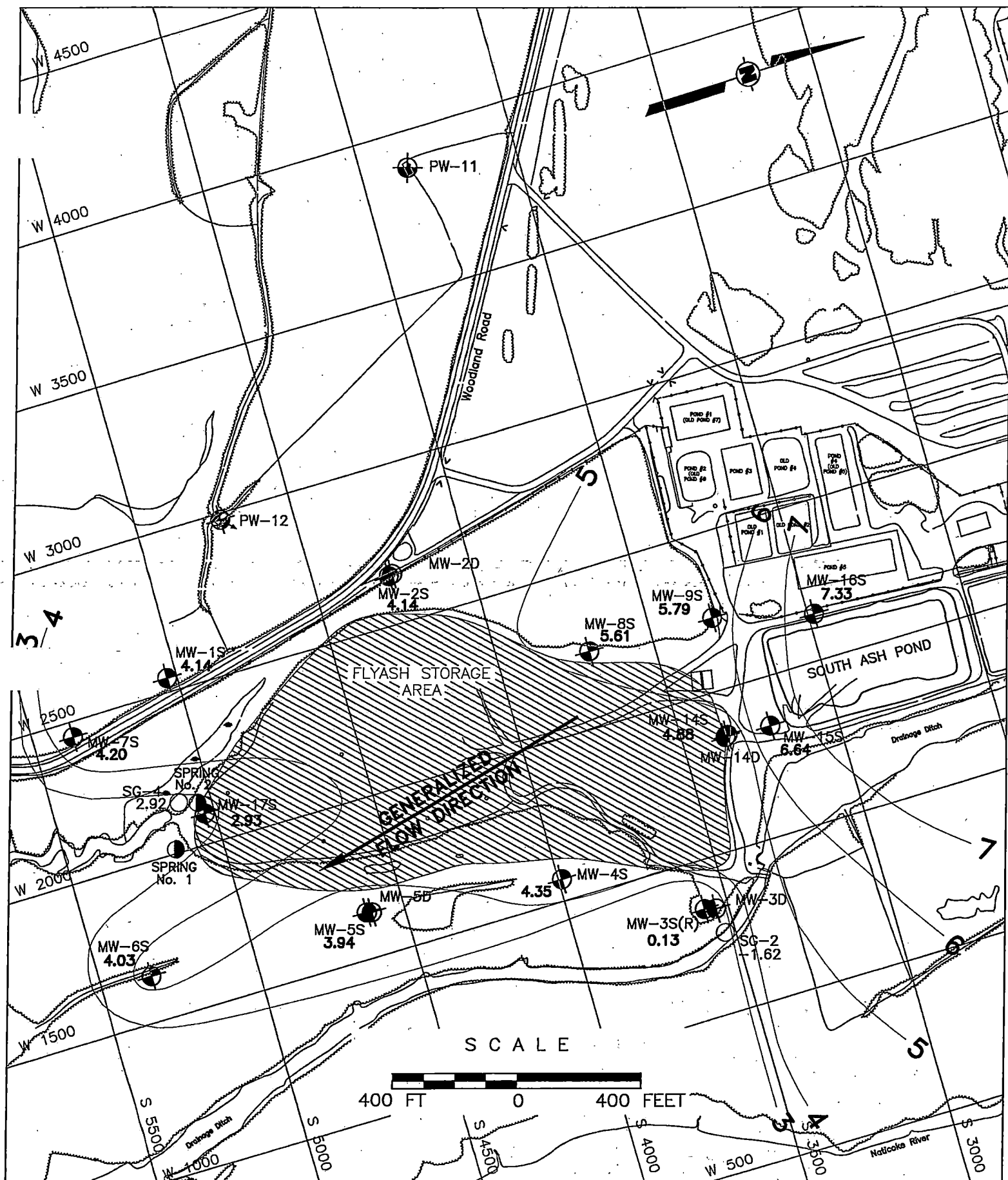
SCALE



SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP APRIL, 2003

Seaford Flyash Landfill
Seaford, Delaware

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As shown				9032A012_2003
DATE	CHECKED	APPROVED	FIGURE	
7/17/03	DEV		2	



LEGEND:

- ⊗ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-5S 3.94 ⊗ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



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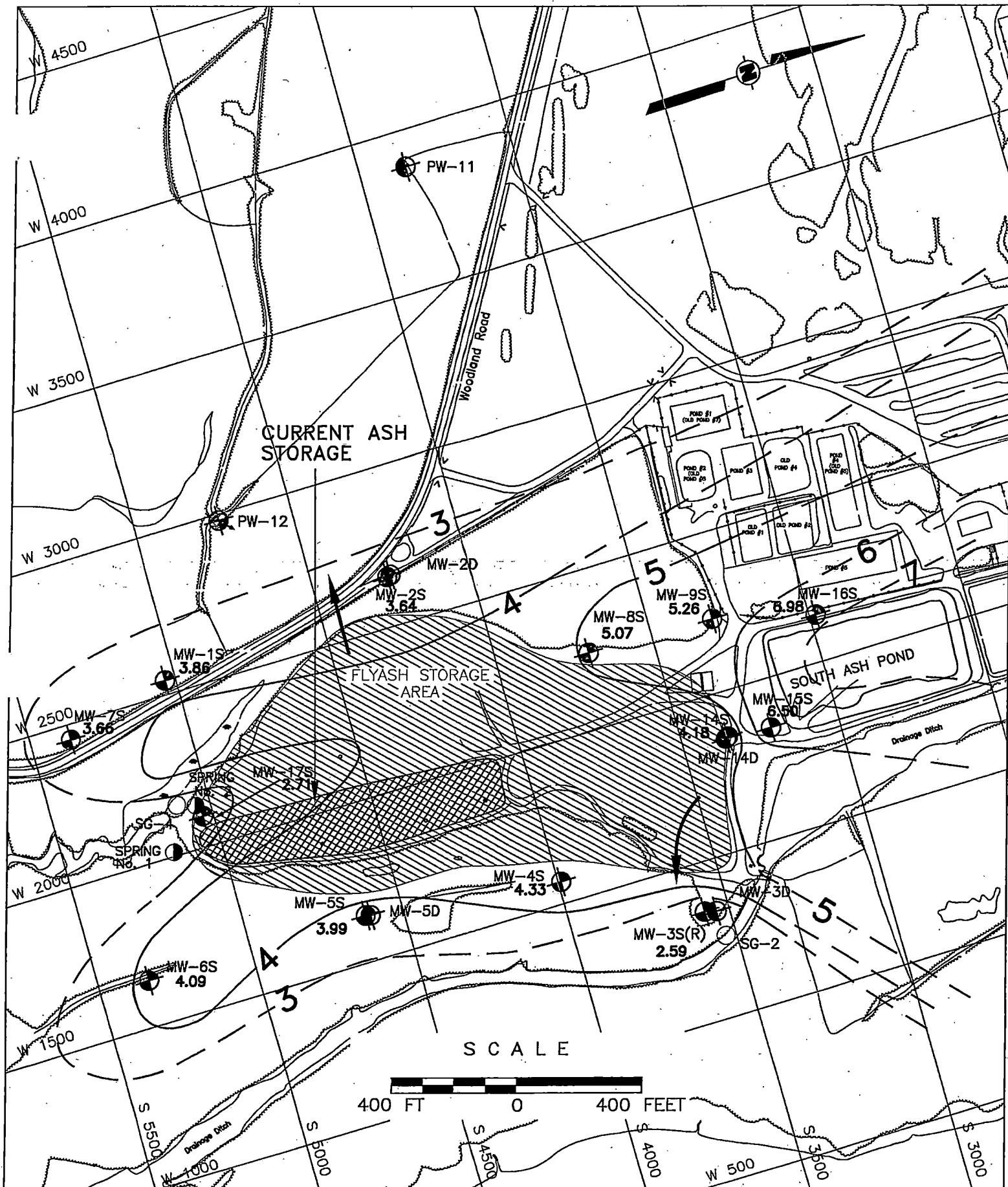
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027



**SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP OCTOBER, 2002**

**Seaford Flyash Landfill
Seaford, Delaware**

SCALE 1"=400'	DESIGNED	DRAWN DEL	CAD FILE NO. S022_OCT_02S-SHALLOW
DATE 12/10/02	CHECKED DEV	APPROVED	FIGURE 1



LEGEND:

- ⊙ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-SS 3.17 ⊙ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



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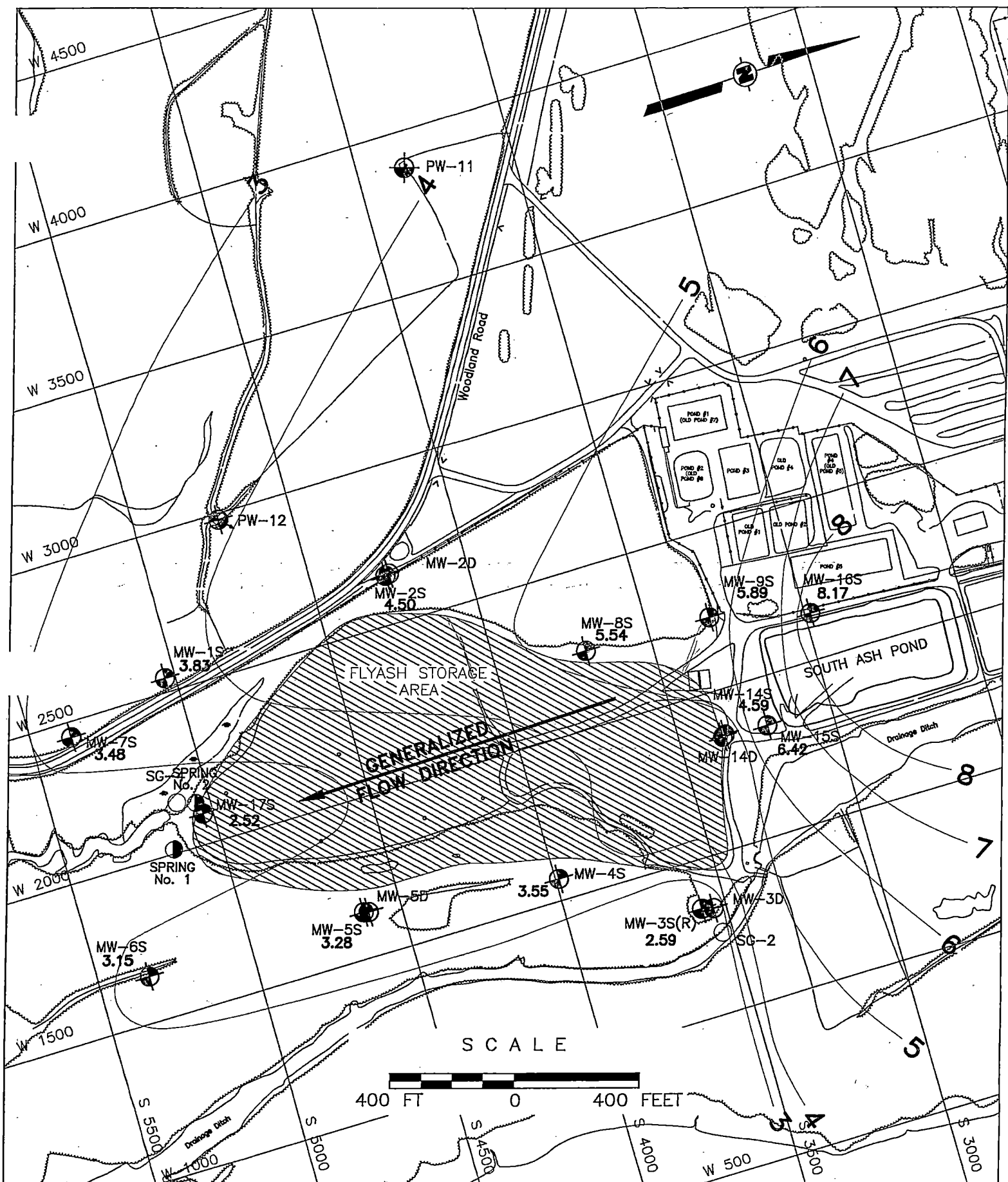
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027



SHALLOW AQUIFER POTENTIOMETRIC SURFACE MAP · APRIL, 2002

**Seaford Flyash Landfill
Seaford, Delaware**

SCALE	DESIGNED	DRAWN	DEL.	CAD FILE NO.
As shown				8052A012
DATE	CHECKED	APPROVED	FIGURE	
7/24/02	DEV		1	



LEGEND:

- ⊕ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MW-SS 3.17 ⊕ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



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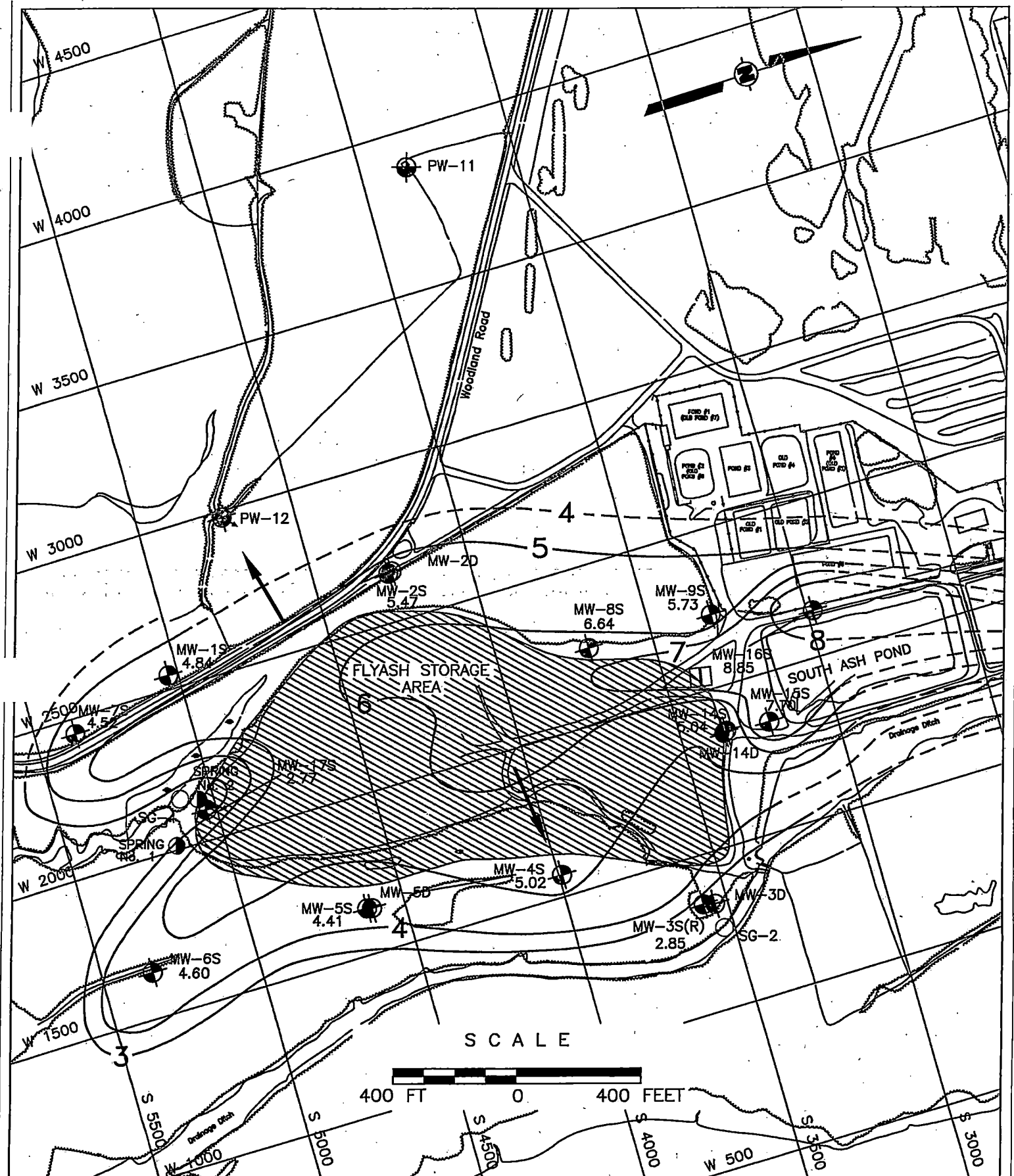
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027



SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP OCTOBER, 2001

Seaford Flyash Landfill
Seaford, Delaware

SCALE 1"=400'	DESIGNED	DRAWN DEL	CAD FILE NO. B052A014
DATE 12/8/01	CHECKED DEV	APPROVED	FIGURE 1



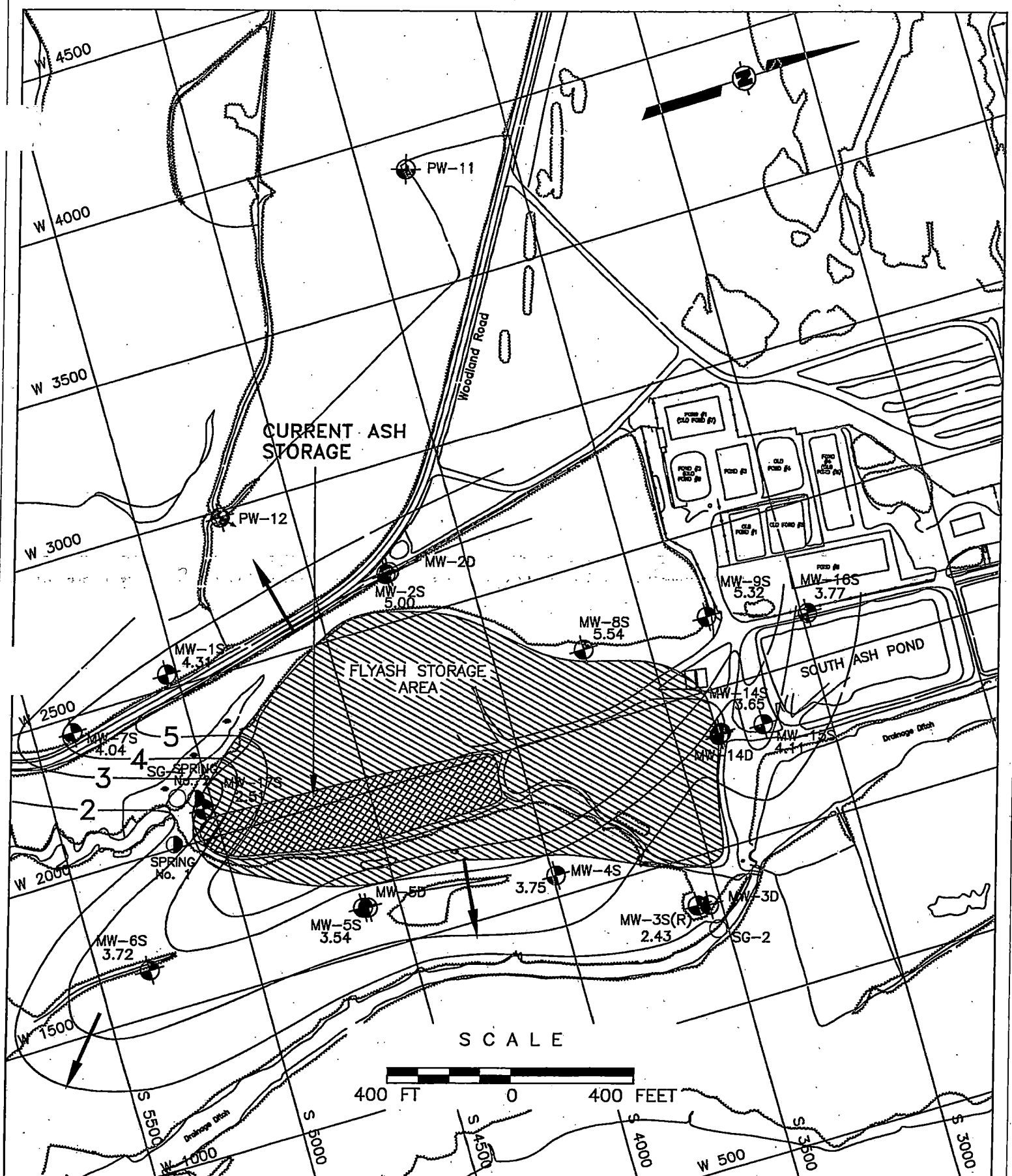
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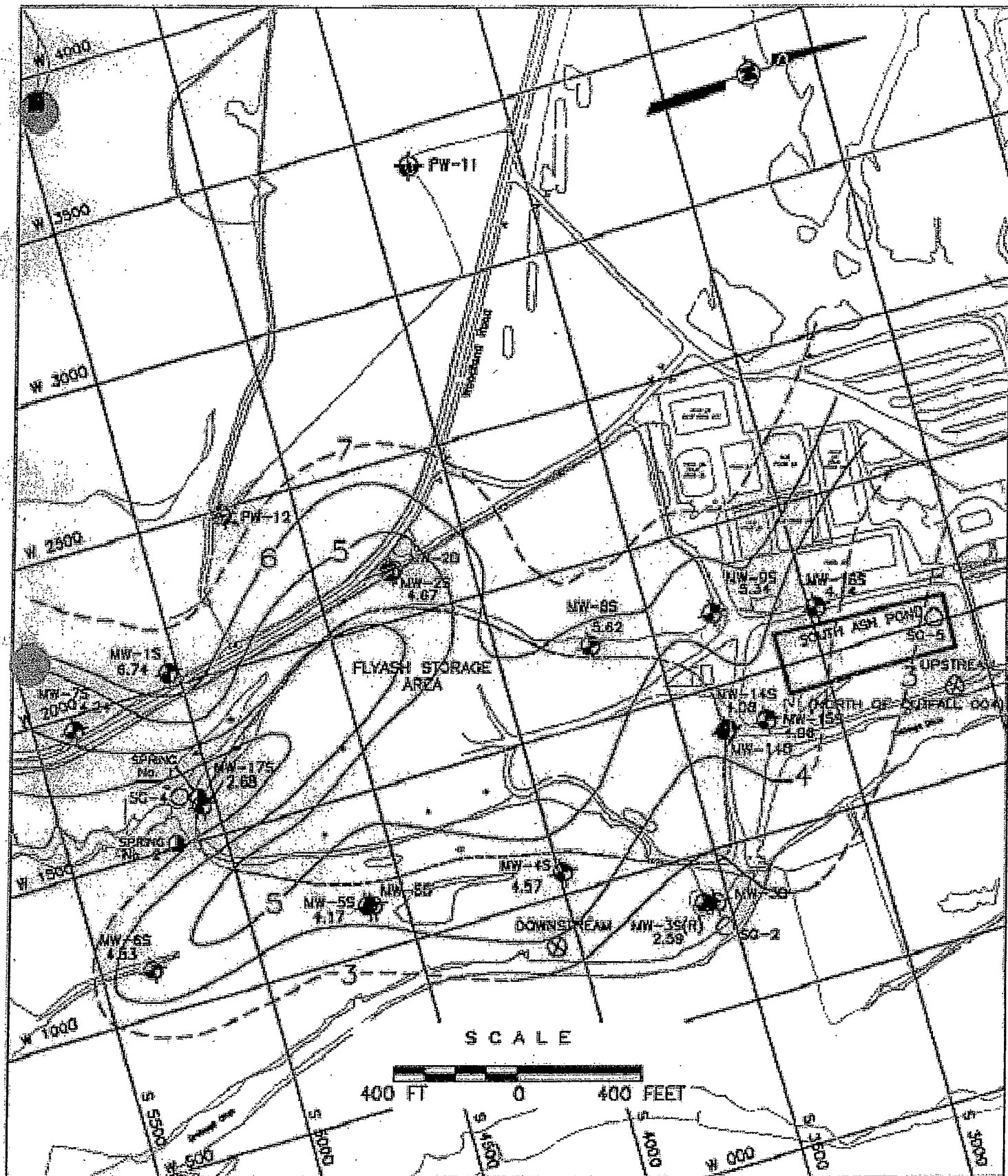
- ⊗ SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- ⊙ MONITORING WELL WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE

SHALLOW AQUIFER POTENTIOMETRIC SURFACE MAP APRIL, 2001

Seaford Flyash Landfill
Seaford, Delaware

SCALE	DESIGNED	DRAWN	DEL	FILE NO.
As shown				0032A012
DATE	CHECKED	APPROVED	FIGURE	
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LEGEND

- SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR
- DIRECTION OF GROUNDWATER FLOW
- MONITORING WELLS WITH GROUNDWATER ELEVATION (MSL)
- STAFF GAUGE



Corporate Remediation Group

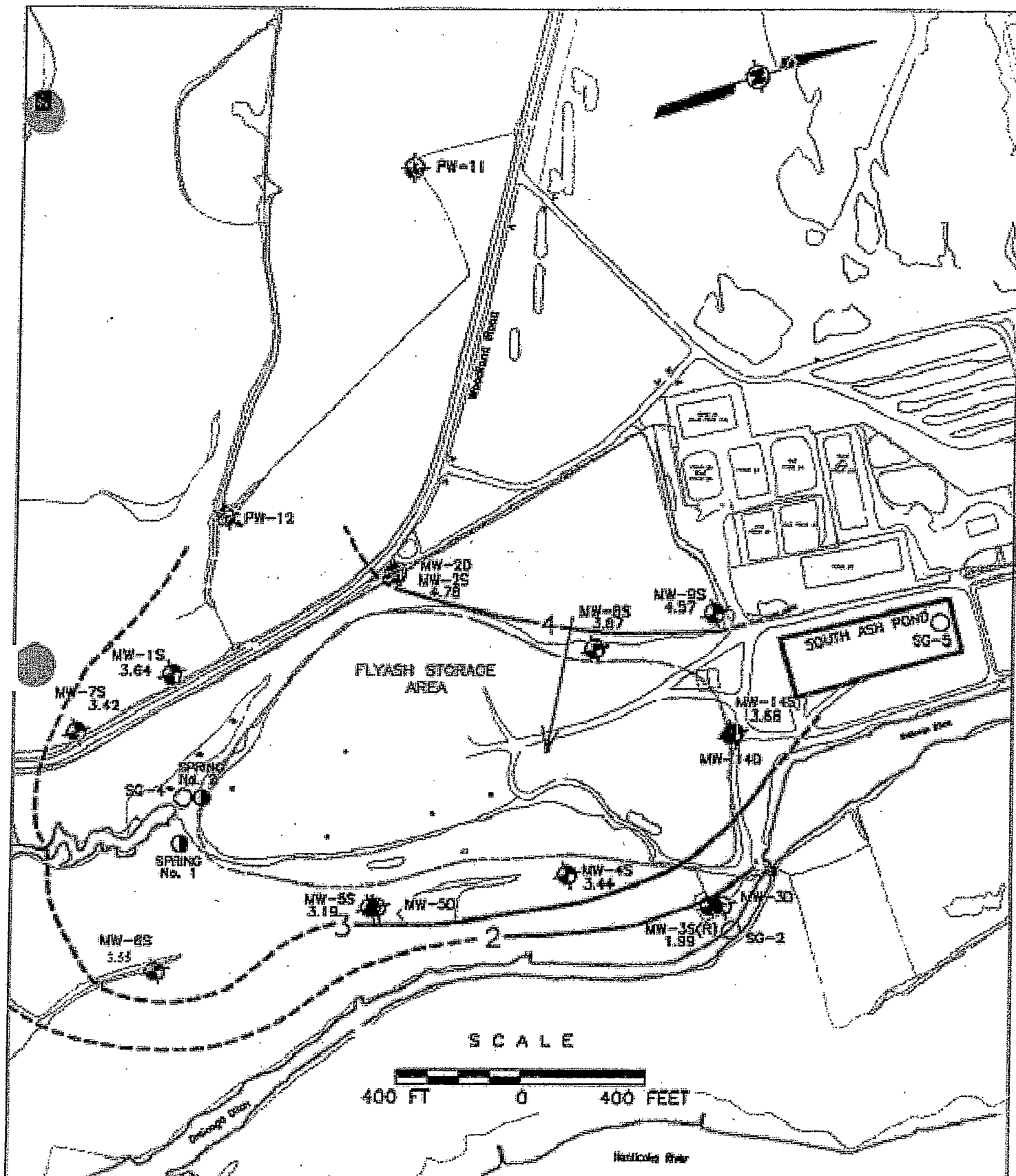
an Alcon Corporation
a part of the P. & T. Chemical Group

Seaford Flyash Landfill, Seaford, Delaware
Monitoring, December 1998-2007

**SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP APRIL 1999**

**SEAFORD FLYASH LANDFILL
SEAFORD, DELAWARE**

DATE	BY	CHKD BY	DATE
7/21/99	FOR		1



LEGEND:

GROUNDWATER ELEVATION
CONTOUR

APPROXIMATE DIRECTION OF
GROUNDWATER FLOW

MONITORING WELL WITH
PUMP



Composite Remediation Group
an AMEREN GROUP
Company and the 6th Maryland Group

Survey and Data Collection
November 1995 - 1996

SHALLOW AQUIFER POTENTIOMETRIC
SURFACE MAP OCTOBER 12, 1998

SEAFORD FLYASH LANDFILL
SEAFORD, DELAWARE

WELL	DATE	COL.	WELL NO.
11/95/98	11/95/98	11/95/98	11/95/98

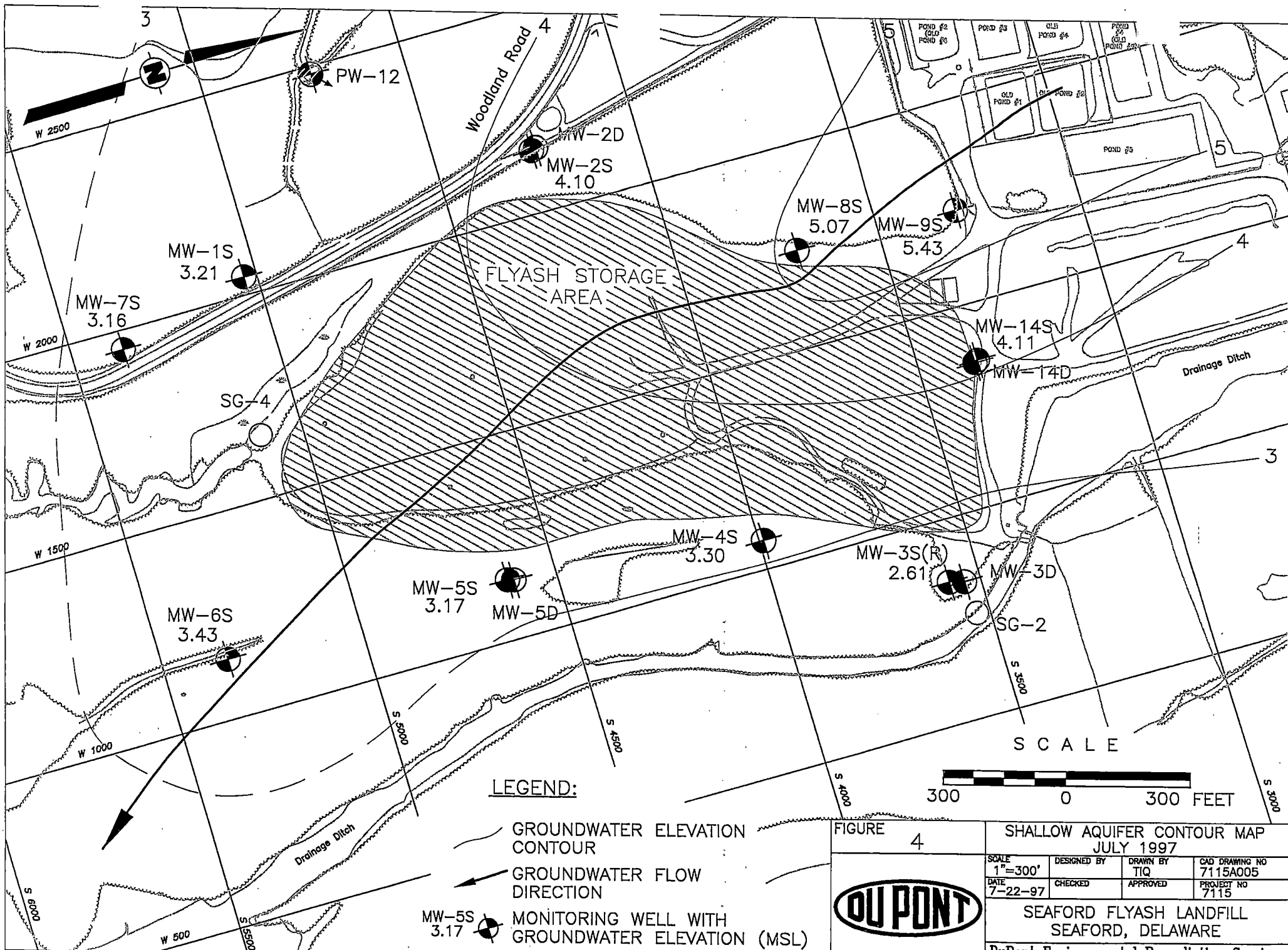

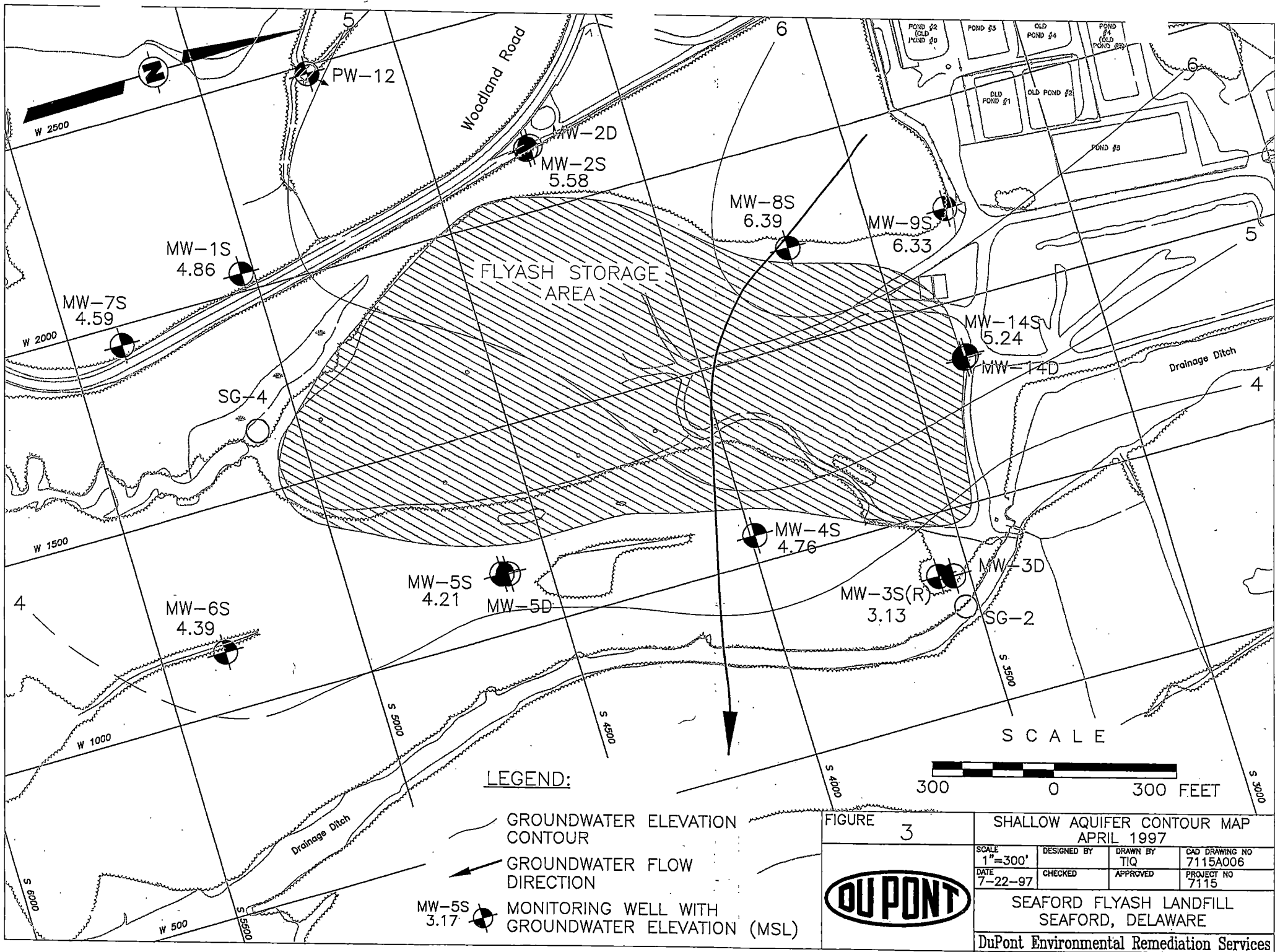
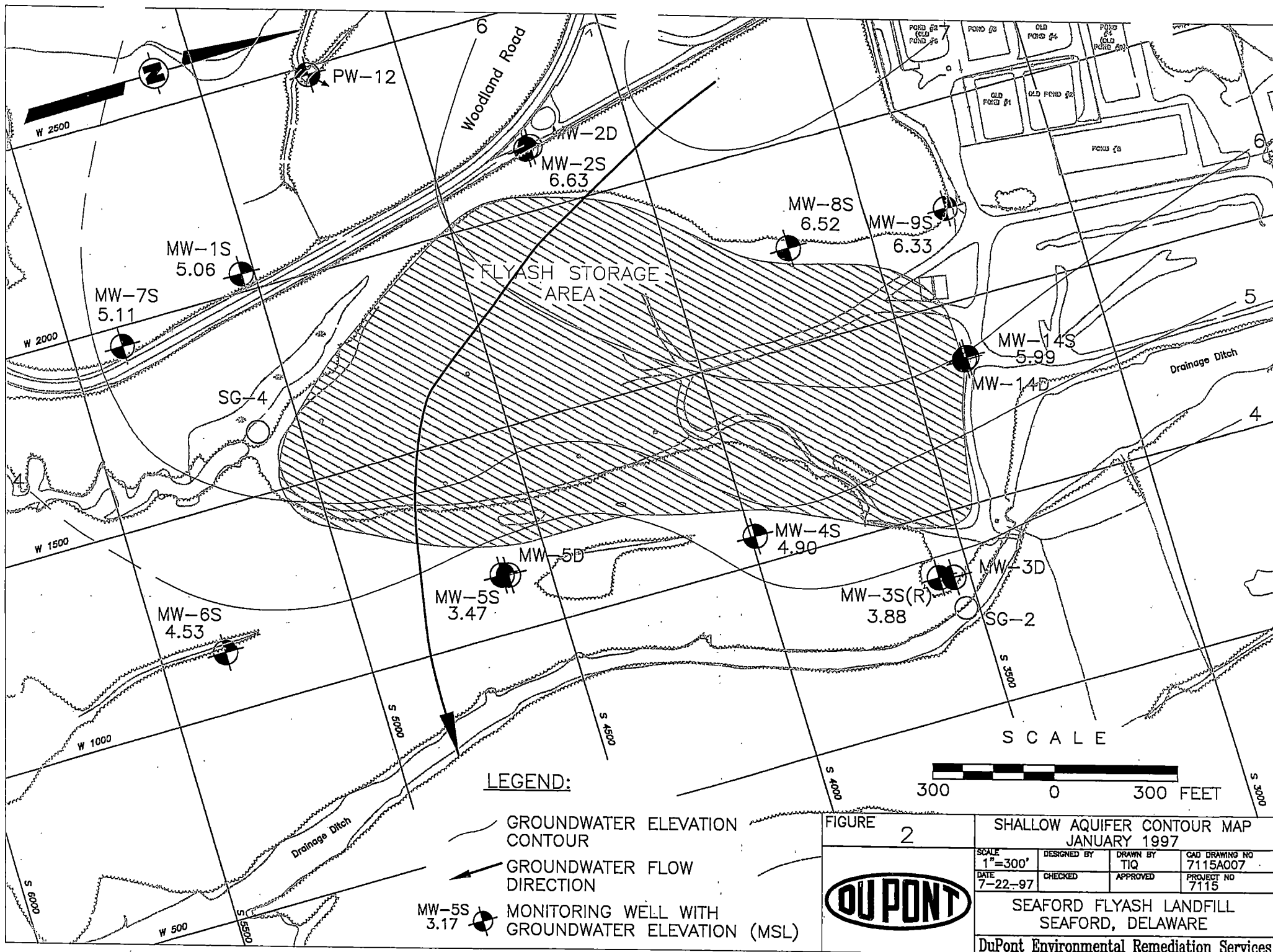
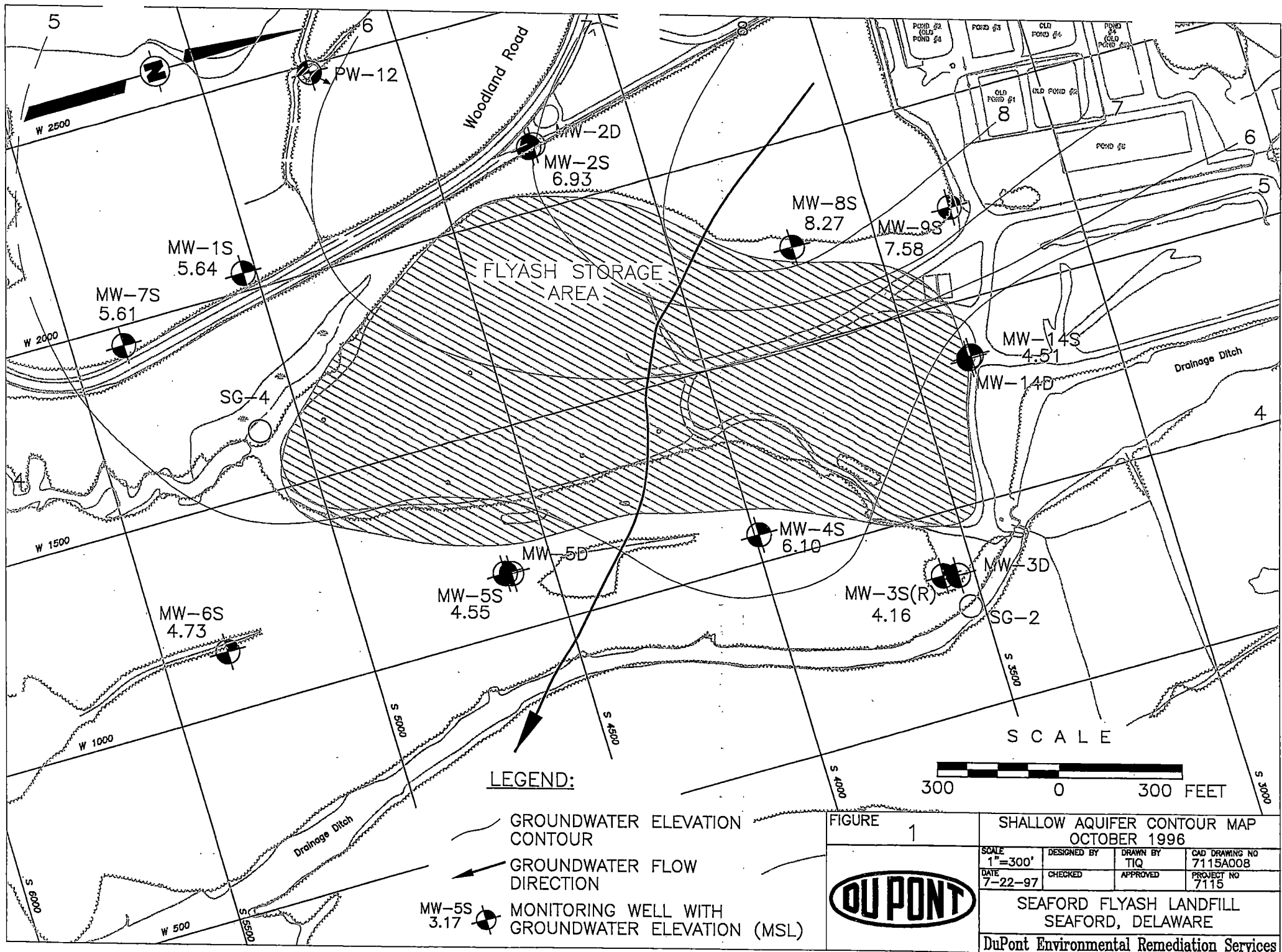
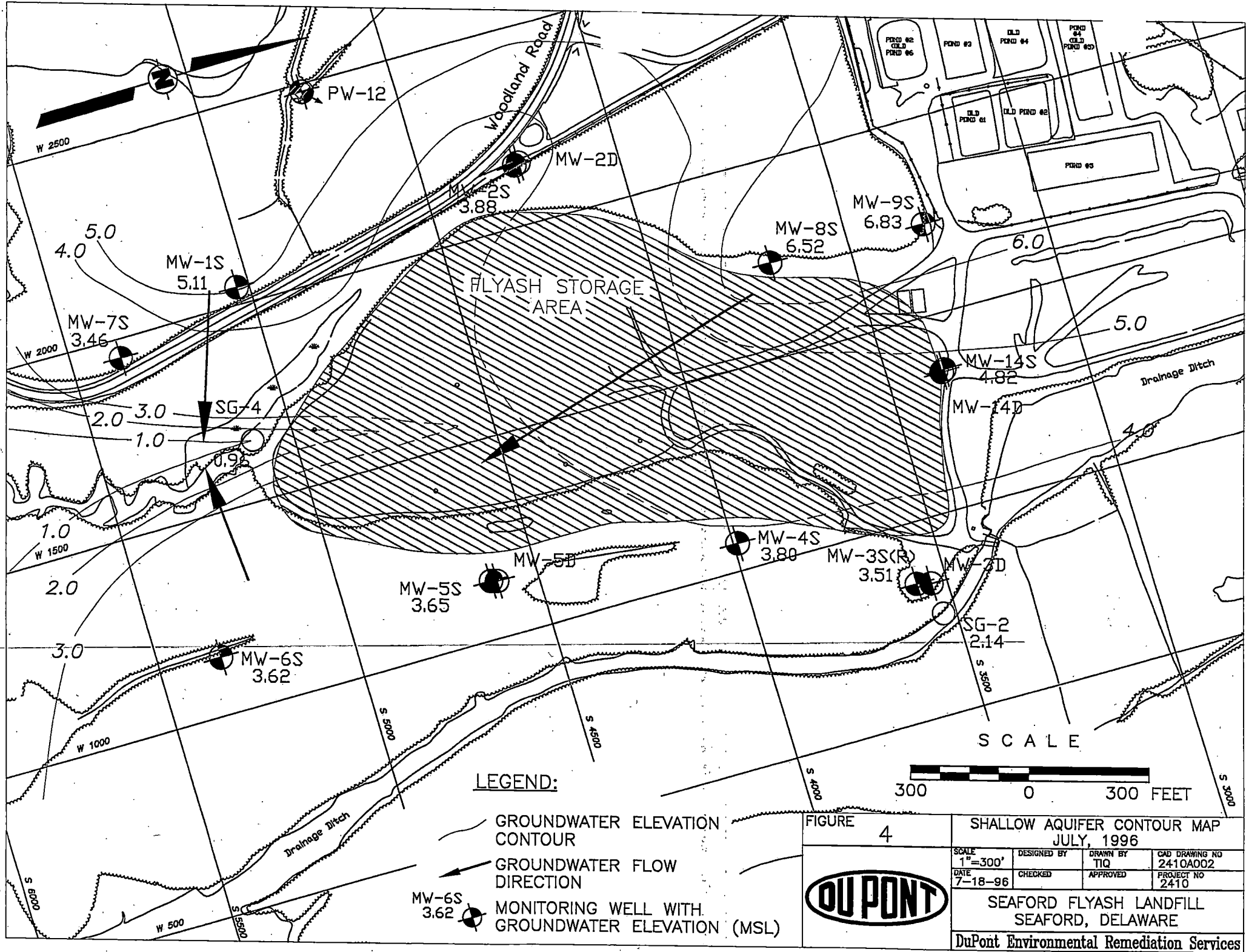


FIGURE 4		SHALLOW AQUIFER CONTOUR MAP JULY 1997			
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	DATE 7-22-97	CHECKED	APPROVED	PROJECT NO 7115	
	SEAFORD FLYASH LANDFILL SEAFORD, DELAWARE				
	DuPont Environmental Remediation Services				









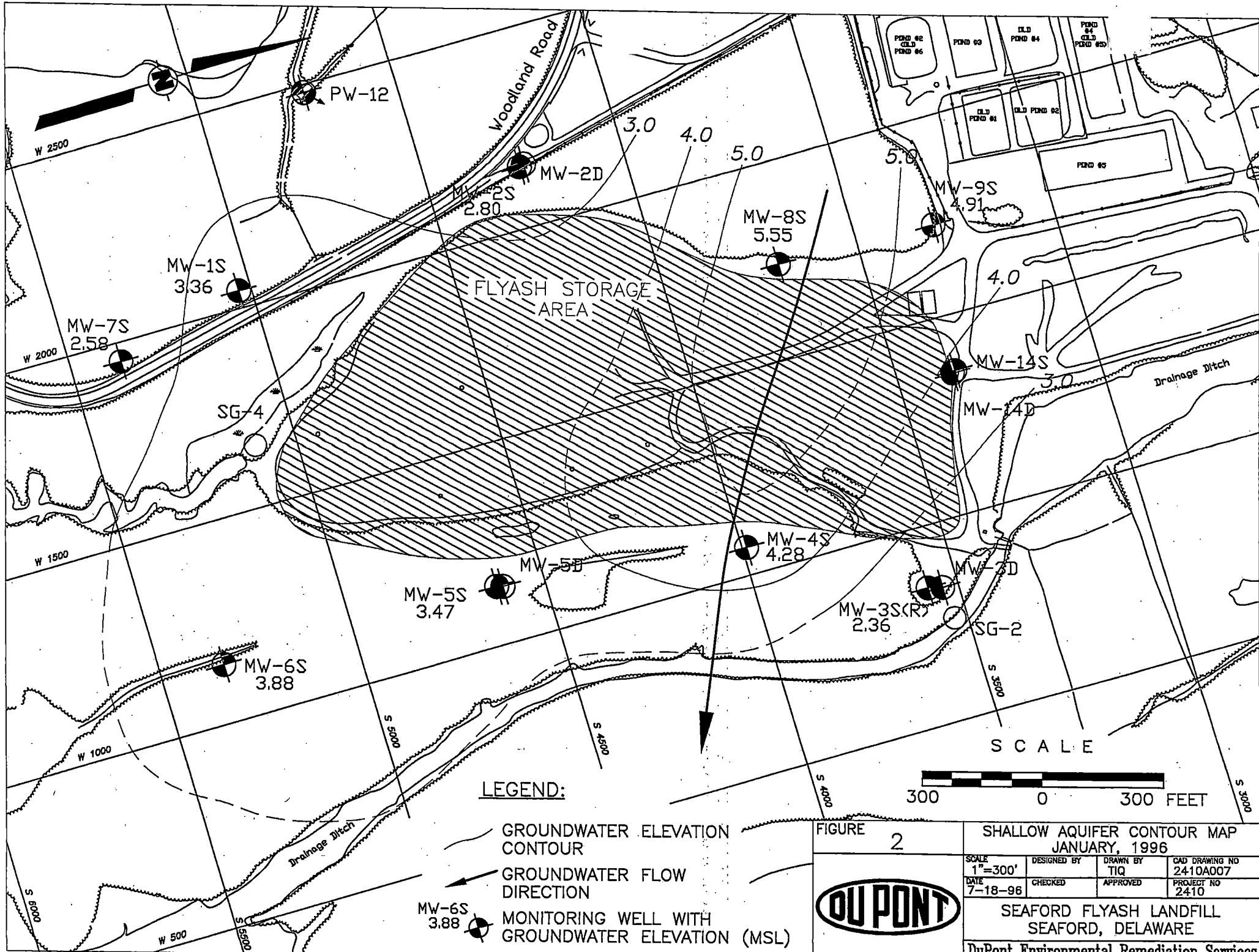


FIGURE 2

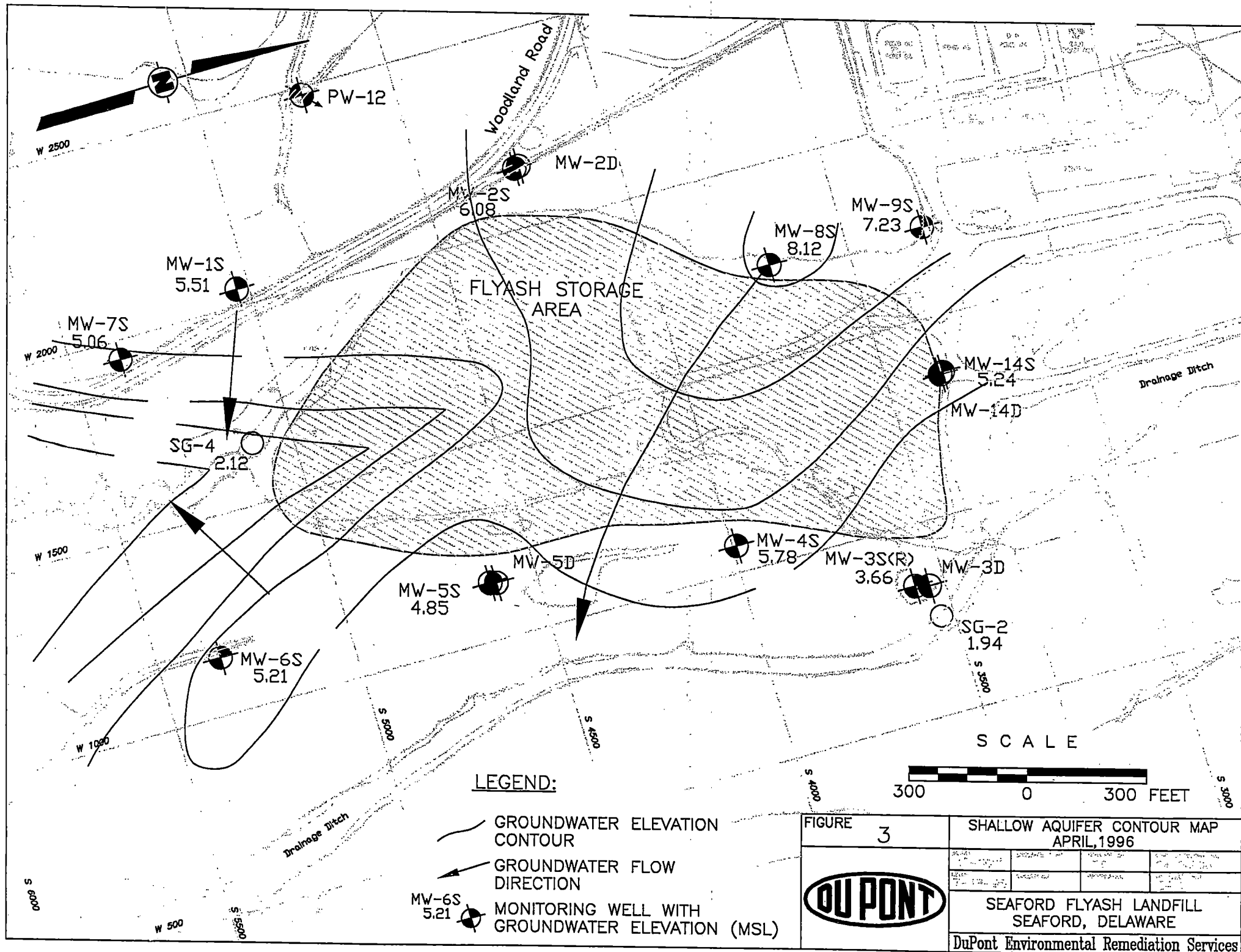
SHALLOW AQUIFER CONTOUR MAP
JANUARY, 1996

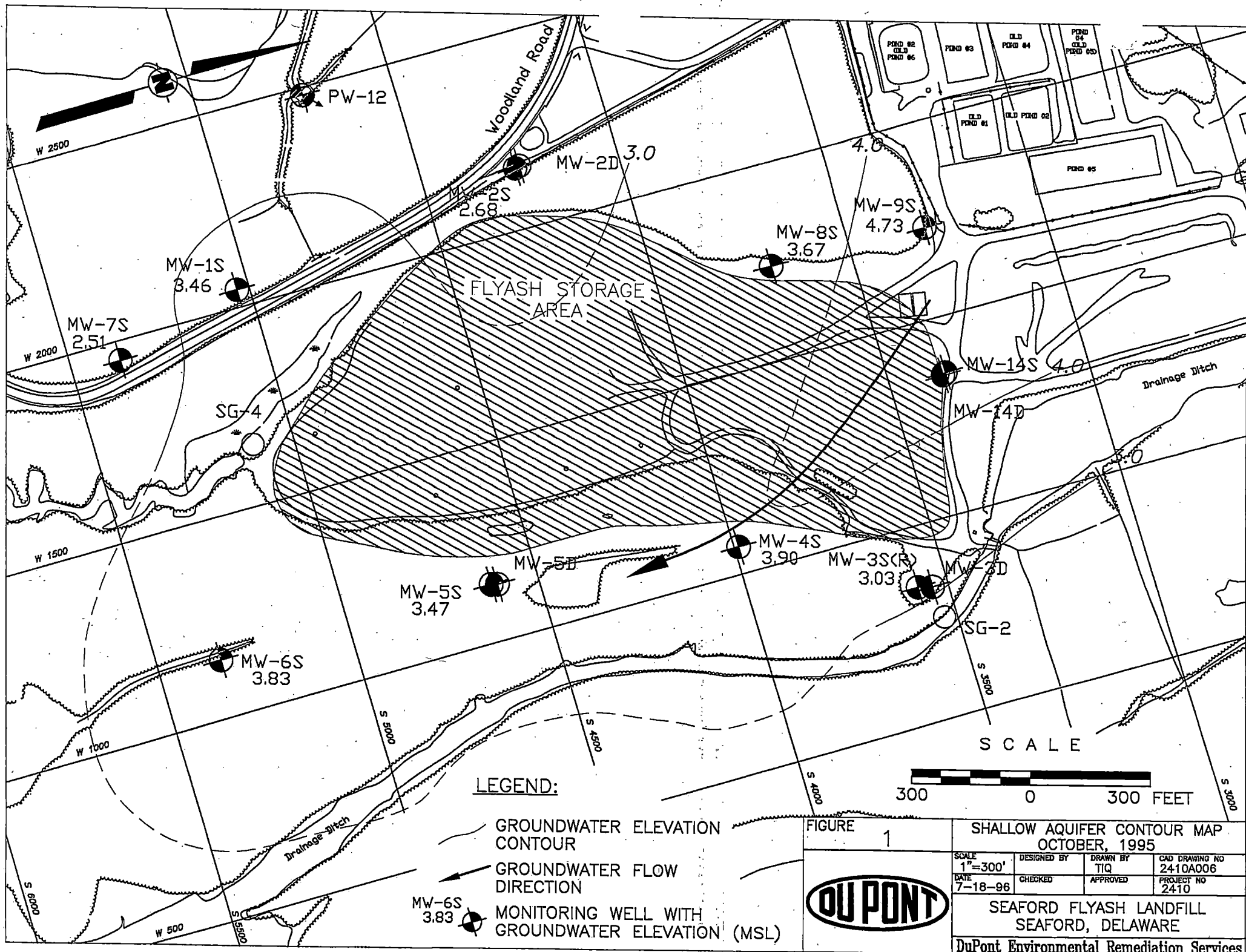


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SEAFORD FLYASH LANDFILL
SEAFORD, DELAWARE

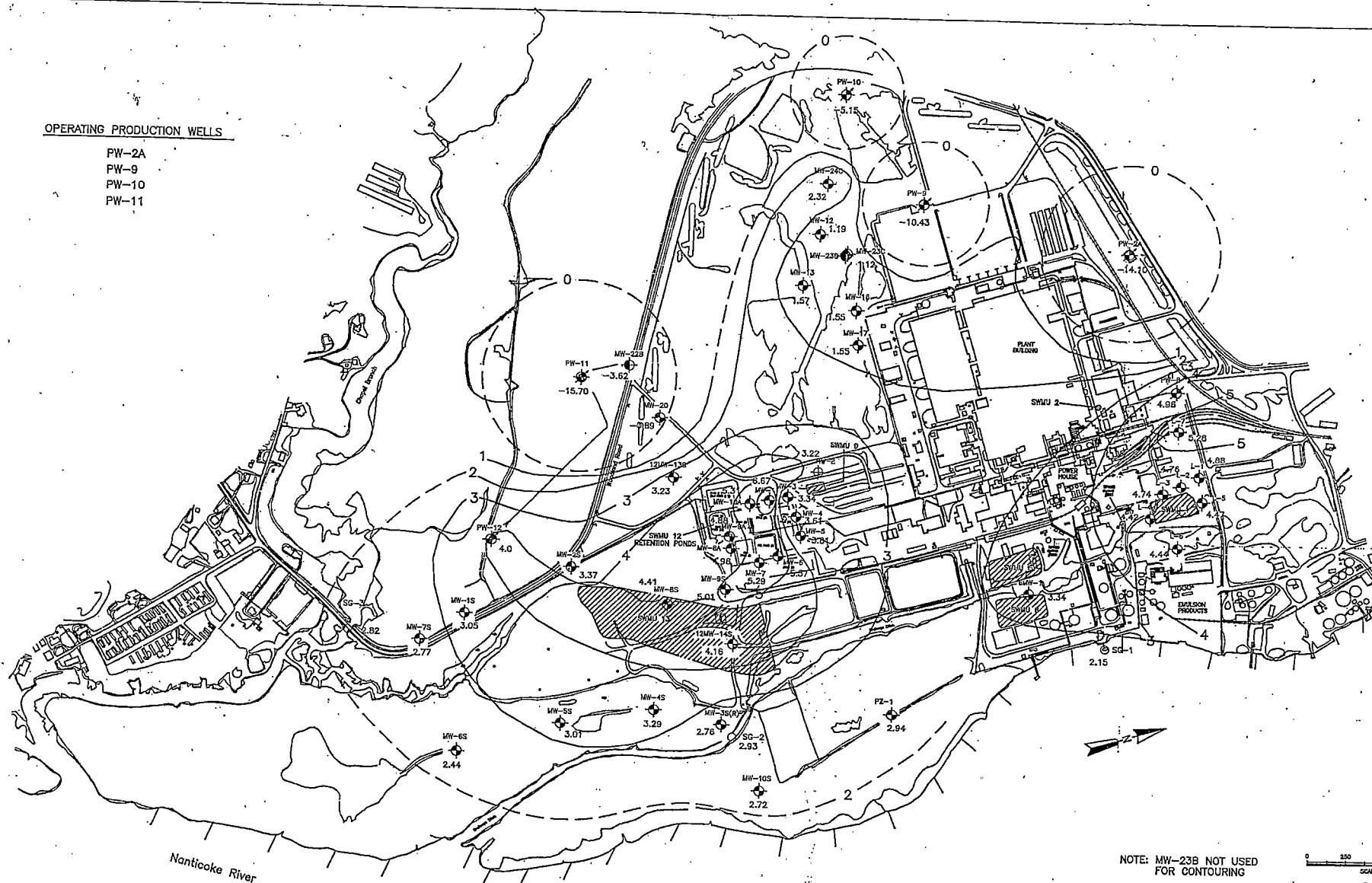
DuPont Environmental Remediation Services



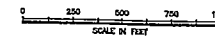


OPERATING PRODUCTION WELLS

PW-2A
PW-9
PW-10
PW-11



NOTE: MW-23B NOT USED FOR CONTOURING



LEGEND

- Shallow Monitor Well
- Deep Monitor Well
- Intermediate Monitor Well
- Staff Gauge
- Abandoned or Unusable Well
- Abandoned Production Well
- Line of Equal Potential Groundwater Surface Elevation (MSL)
- Generalized Groundwater Flow Direction
- Active Production Well

NO.	REVISIONS	BY	DATE
1	REVISED IN RESPONSE TO USEPA'S COMMENTS OF JANUARY 27, 1993		5/11/93
2	REVISED IN RESPONSE TO USEPA'S COMMENTS OF FEBRUARY 3, 1994		2/28/93

DESIGNED	INITIALS
DRAWN	
CHECKED	
APPROVED (DESIGN)	
APPROVED (CONSTRUCTION)	



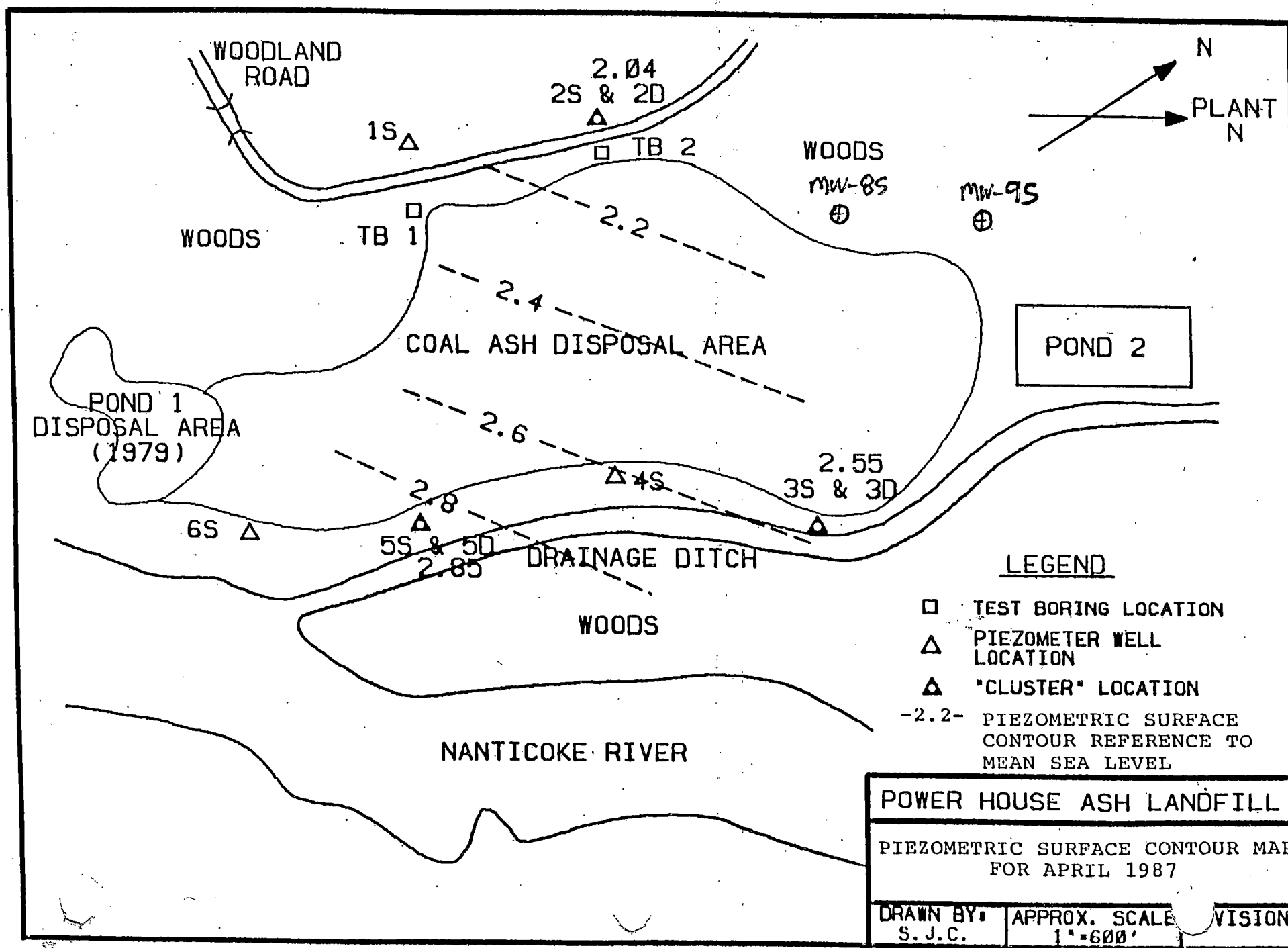
Corporate Remediation Group
An Alliance between
DuPont and The W-C Diamond Group

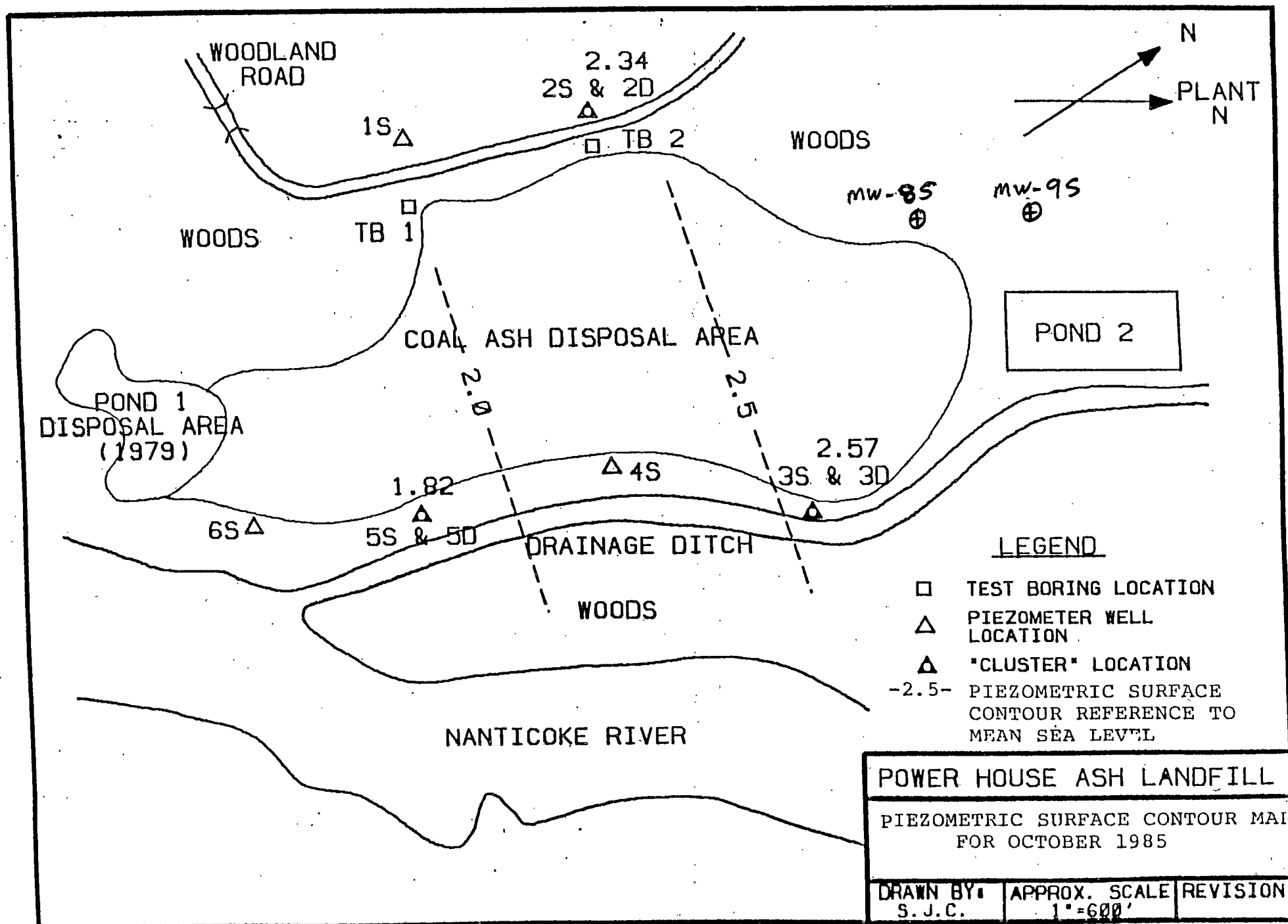
Barley Mill Plaza, Building 27
Wilmington, Delaware 19860-0027

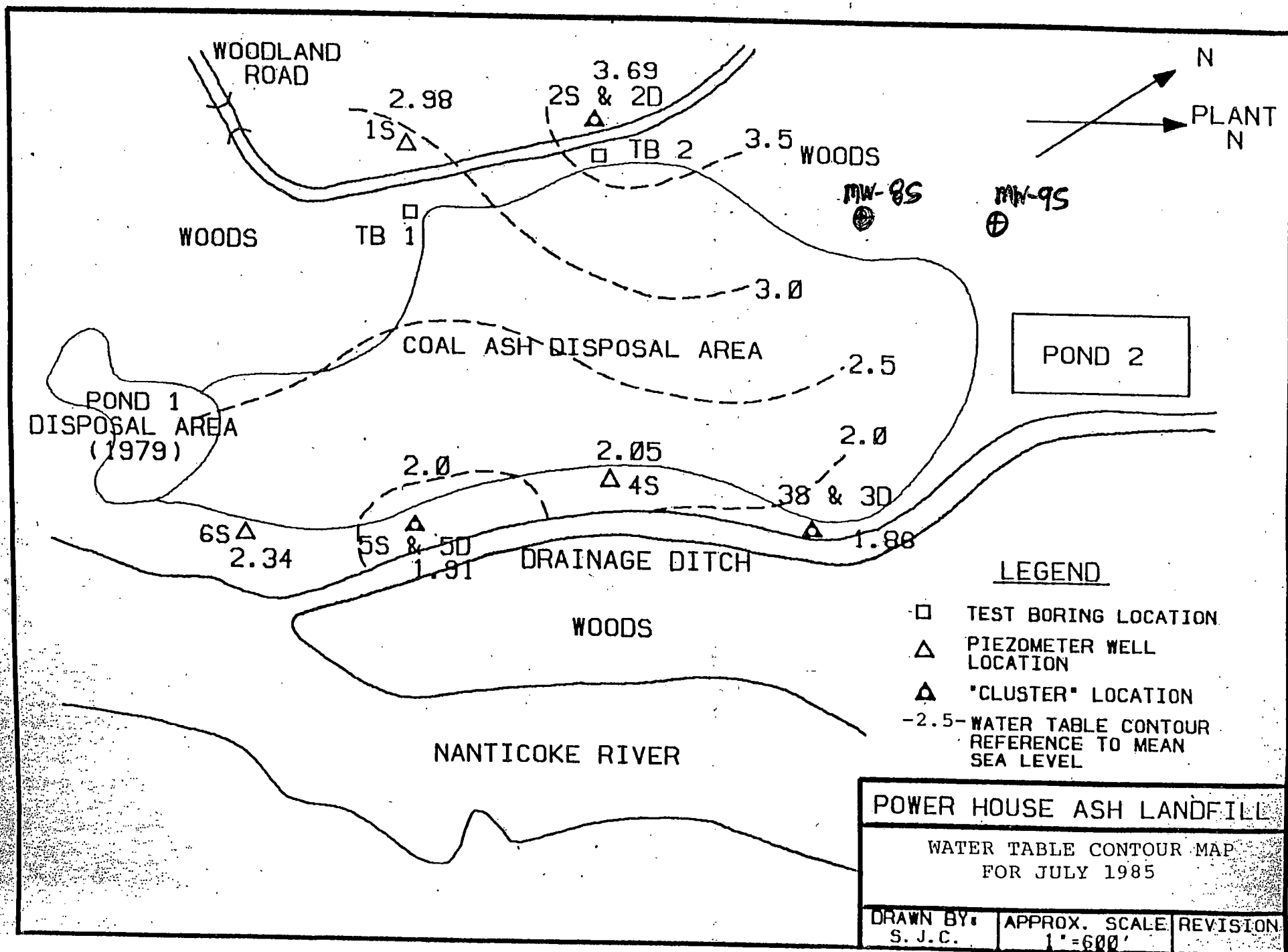
GROUNDWATER FLOW DIRECTIONS FOR
THE SHALLOW SATURATED ZONE,
NOVEMBER 18, 1994 - HIGH TIDE

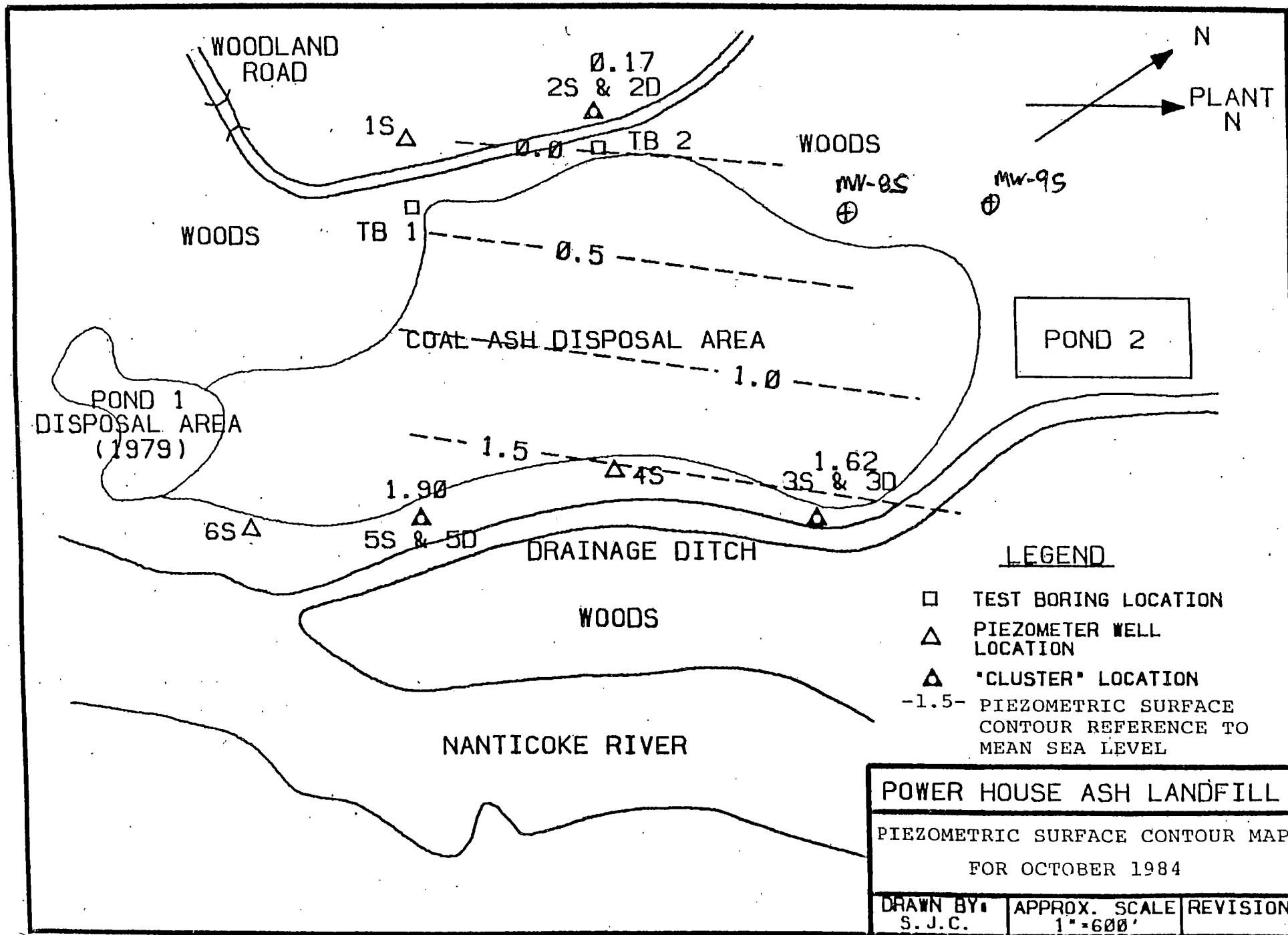
DuPONT SEAFORD NYLON PLANT
SEAFORD, DELAWARE

SCALE: 1"=550' DATE: 5/11/93 GWT FILE NO.: 2755A001-11 DRAWN: 8









Michael R
Liberati/AE/DuPont
10/04/2004 02:32 PM

To Rachel.Colella@state.de.us
cc
bcc Matthew P Brill/AE/DuPont
Subject Iron in the Seaford region

Hello Rachel,

Attached is the document that I mentioned.



Iron in Seaford Region Document.pdf

Memorandum

To: Mike Liberati, DuPont CRG
cc: Ceil Mancini, URS and Matt Brill, URS Diamond
From: Dr. Darrel Lauren, URS
Date: 10/01/04
Re: Iron in the Environment in the Seaford Region

EPA has expressed concerns over potential impacts to "forested wetlands and surface waters of Lewis Creek". As we discussed, DuPont acknowledges that the landfill may be an additional source of iron to the ecosystem, but it is in an area and system documented to have high background iron concentrations that result in the nature of the forested wetlands and surface waters adjacent to the site. The following text provides:

- The history and chemistry of iron in the Delmarva Peninsula
- Potential toxicity of iron and iron precipitates in surface water
- Potential toxicity of iron and iron precipitates in sediments

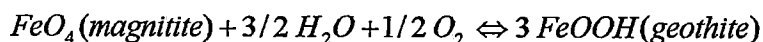
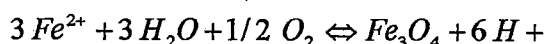
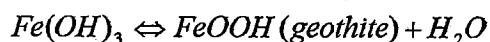
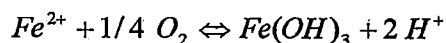
1.0 History and Chemistry of Iron in the Delmarva Peninsula

The site is located in a region of Sussex County, Delaware with a long recorded history of high levels of iron in groundwater precipitating in surface waters. This history is well documented because iron from naturally occurring deposits of bog iron was an important source of revenue to the early colonists. This was particularly true for the area known in colonial times as the Nanticoke Hundred, which included the towns of Middlefield and Concord to the east of Seaford. These towns had "bloomery" iron forges (Scharf 1888) before the Revolution that shipped iron directly to England. After the Revolution, bog iron from this region was shipped to iron makers in Basto, New Jersey and Philadelphia until the mid-1800's when richer, purer, sources of iron were discovered and exploited. Bog iron formed at such a rate that previously mined sources could be re-mined within a few years (Bricker et al. 2003).

Along the Delmarva Peninsula bog iron forms when iron-rich groundwater from quartz-rich barrier beach type deposits reaches the surface in springs (Bricker et al. 2003). Bog iron is a naturally occurring crystallization of the precipitate that forms when reduced (i.e., ferrous, Fe^{2+}) iron, dissolved in groundwater, reaches the surface where oxygen is available (Figure 1). The chief iron salts formed at circumneutral pH are ferric (Fe^{3+}) oxyhydroxides, such as magnetite (Fe_3O_4) and goethite ($\text{FeO}(\text{OH})$) although there are at

least eight other iron oxyhydroxide salts. When present in sufficient density, yellow to rust-red iron oxyhydroxides (i.e., ochre) form flocs such as those that occur in the wetlands and surface waters in the landfill vicinity. Because of the mass and surface area of iron oxyhydroxides, in slow-moving water bodies these flocs continue to precipitate and form a red "mud" which, when covered by subsequent precipitation, forms black bog iron. Some of this color range is dependent upon the density of the crystals mass formed. For instance, solid black hematite when ground to a fine powder is red.

Figure 1. Formation of iron oxyhydroxides in spring water from iron-rich groundwater



2.0 Potential Toxicity of Iron and Iron Precipitates in Surface Waters

The nature of metals in surface water is important since it dictates their environmental fate and mode of toxicity. Metals in water are defined as either "total recoverable" or "dissolved". Total recoverable metals are simple acid-solubilized samples without prior treatment to remove particulates, while dissolved metals have been passed through a 0.45 um filter to remove particulates. This is important because while total recoverable metals may cause physical toxicity (i.e., suffocation) only the dissolved portions of metals are bioavailable to cause chemical toxicity (i.e., ionoregulatory failure) to aquatic organisms.

Naturally occurring red mud bogs such as those that occur in the site vicinity, and total recoverable concentrations of iron in groundwater exceeding 20 mg Fe/L have been reported in the Nassawango Watershed in the southwestern Delmarva Peninsula (Bricker et al. 2003). Similarly, total recoverable iron in groundwater collected upgradient from the ash pile at the DuPont Seaford site (Site) ranged from 10 to 19.2 mg Fe/L in 2002 and 2003. Therefore, total recoverable iron in groundwater at the Site is within the range found naturally in the Delmarva Peninsula.

A highly conservative assessment of risk to aquatic receptors from the chemical toxicity of dissolved iron in the Site vicinity may be evaluated by comparing the dissolved fraction of the groundwater to the National Ambient Water Quality Criterion (NAWQC) of 1000 ug Fe/L¹. Since the dissolved iron concentration in Lewis Creek adjacent to the Site ranged from 971 to 289 ug Fe/L, lower than the NAWQC, there is no risk to aquatic receptors from the Site. Furthermore, the total recoverable iron concentration in Lewis Creek adjacent to the Site ranged from 566 to 4,570 ug Fe/L in 2002. In field studies in neutral waters containing a total recoverable concentration of 4,200 ug Fe/L, Robbins et

al. (1997) found dragonflies, caddisflies, and water beetles. This suggests that similar aquatic organisms would be present in Lewis Creek adjacent to the Site.

3.0 Potential Toxicity of Iron and Iron Precipitates in Sediments

The only available freshwater sediment screening guideline values for iron are derived from multi-chemical effects data that are not specific to iron. Persaud et al. (1990) derived low and severe effect levels for iron in sediment of 2 and 4% (20000 and 40000 mg Fe/kg), respectively. However, because the data came from natural sediments in which many other chemicals were present, the effects cannot be directly linked to the iron concentration alone. In fact, using the same "guilt-by-association" approach in which every chemical is assumed to be responsible for the toxicity that may be caused by only one of the chemicals present, Ingersoll et al. (1996) calculated low and median adverse effects concentrations for total organic carbon (TOC) and acid-volatile sulfides (AVS). These compounds are known to alleviate the toxicity of organic chemicals and metals, but because they were present in sediments that caused toxicity, it was assumed that TOC and AVS were toxic. It is informative that in the last revision of the freshwater sediment screening guidelines (MacDonald et al. 2000), no screening value for iron was proposed, and no tests of iron alone have ever been conducted. However, in field studies in neutral waters containing 272,000 mg Fe/kg sediment, Robbins et al. (1997) found dragonflies, caddisflies, and water beetles. In contrast, iron concentrations measured in Lewis Creek sediments adjacent to the Site ranged from 4,650 to 53,400 mg Fe/kg. This suggests that precipitated iron would be non-toxic to benthic and pelagic invertebrates.

4.0 Summary

Based on the lines of evidence presented above, there is little likelihood that the groundwater that enters Lewis Creek as a result of leaching from the ash pile at the Site contributes any additional toxicity to that which is inherent in the naturally occurring ambient groundwater. The site is located in a region with a long history of naturally high levels of iron in groundwater that precipitates in surface waters. Native biota are likely adapted to high ambient iron concentrations. Since the dissolved iron concentrations in groundwater in the site vicinity are lower than the NAWQC, groundwater is further diluted in Lewis Creek, and all surface water data show that iron concentrations are below ecological criteria, it is not likely that iron poses a threat to aquatic receptors in the area.

5.0 References

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1) The NAWQC for iron is based on a single field study where trout were exposed to acid mine drainage and is not consistent with the current method for deriving water criteria (Suter and Tsao 1996). Furthermore, fish are far more sensitive to low pH than to iron or any other metal that might have been present in the acid mine drainage. Therefore, Suter and Tsao (1996) cite the study by Beisinger and Christensen (1972) as a more appropriate benchmark of iron toxicity data. These authors reported an EC16 for reproduction in *Daphia magna* of 4,380 ug Fe/L.

However, iron oxyhydroxide precipitation presents problems to assigning a reproducible water quality benchmark. Beisinger and Christensen (1972) used a colorimetric method to measure the iron concentration and precipitate was likely measured as well as the dissolved fraction. More recent studies have also encountered problems keeping iron in

solution during bioassays. Lappivaara et al. (1999) reported that juvenile whitefish showed signs of suffocation (i.e., physical toxicity due to precipitation on the gills) at a nominal concentration of 8,000 ug Fe/L but that this concentration had to be maintained by addition of fresh ferric hydroxide every other day. Such episodic addition and of precipitation would not be expected to occur in natural systems. In order to identify the "true" dissolved iron fraction, these authors resorted to centrifugation at 2000 g for 5 minutes to remove the precipitates. The "true" dissolved fraction was below 400 ug Fe/L. Therefore, attaining the NAWQC as dissolved iron at circumneutral pH may not be physico-chemically possible.

Even filtration at 0.45 um and centrifugation at 2,000 g may not be sufficient to separate precipitates from colloids and dissolved iron. Estimating the iron concentration causing adverse effects is made more difficult because the size of iron oxyhydroxide precipitates changes over time. Iron oxyhydroxides initially exist as colloids that change in size from nm to um (Buffle and Leppard, 1995) as they aggregate into particulates over time and thus they may pass through the 0.45 um filter traditionally used to separate dissolved from total recoverable metals. Because of this potential artifact of sample processing, Kimball and Stanley (1997) used ultrafiltration to separate the dissolved (<0.001 um) from the colloidal (>0.45 um >0.001 um) iron fractions. Therefore, assuming that 0.45 um filtered samples contain only dissolved iron would provide an erroneous indication of the free iron concentration to which organisms are exposed. Because of the problems associated with iron oxyhydroxide precipitation, there is no appropriate toxicity benchmark by which to analyse risk from iron to aquatic organisms. In this case, naturally-occurring background should serve as the benchmark. This does not indicate that iron is without physical toxicity, only that physical toxicity due to iron precipitation is a naturally-occurring phenomenon.

Natural systems rarely consist of metal ions and water alone. Therefore, Lappivaara et al. (1999) also investigated the role of humic acids on iron bioavailability and toxicity. Humic and fulvic acids are important breakdown products of leaves and other vegetation and swamp and woodland bog waters have particularly elevated levels of these compounds. The water collected from a peat production area contained a total recoverable concentration of 2430 ug Fe/L after dilution by 20% (i.e., 80% peat water), and a dissolved concentration of 350 ug Fe/L. In this water the bioaccumulation and physiological effects of iron were negligible on whitefish after 30-days of exposure. Therefore, it is possible that the iron in the bog water at the Site would likewise cause no adverse effects from either precipitated or dissolved iron.